Digi-Sense®

Model No. 8528-12 (JTEK)

INTRINSICALLY SAFE THERMOCOUPLE THERMOMETER

Cole-Parmer Instrument Company
Chicago, Illinois 60648

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Telex 28-9405
A-1299-395
Edition 1391

MP MASTER
MA32050

INTRINSICALLY SAFE JTEK THERMOCOUPLE THERMOMETER

The Intrinsically safe JTEK thermocouple thermometer is CSA certified per standards C22.2 No. 0-M1982 and 157-M1987 for use in Class I, Groups A, B, C and D locations.
Temperature code: T3C

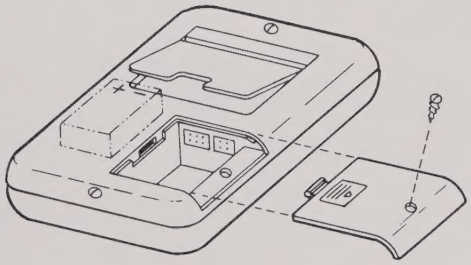
BATTERY REPLACEMENT

(Disregard Page 17)

L. BAT

A "L.BAT" notation in the display will warn you when there is 10-15 hours of useful life remaining. Replace 9V battery with Duracell P/N MN1604 or Eveready "Energizer" P/N 522. The battery compartment is on the backside. To open, remove battery cover screw and push cover in direction of arrow. Verify battery orientation and polarity are correct before inserting replacement battery.

NOTE: When the "L. BAT" indicator is on the electronic memory is disabled. An "Err6" message will briefly appear when the unit is turned off indicating STORE and CAL constants will not be saved.



Warning:
TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, BATTERIES MUST BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.

Avertissement:
AFINDEPREVENIRL 'INFLAMMATION D'ATMPSHERES DANGEREUSES, NE CHANGER LES BATTERIES QUE DANS DES EMPLACEMENTS DESIGNES NON DANGEREUX.

Caution:
Be sure to disconnect probe when changing battery. This will avoid any possible electrical shock hazard if the probe is accidentally connected to a high voltage source.

J•T•E•K Thermocouple Thermometer

We call it the "J•T•E•K" because this handheld *precision* thermometer is designed to accommodate the four most popular thermocouple types (K, J, T, E), over the full ASTM and NBS ranges.

It's also a "breakthrough" instrument because unlike conventional digital thermometers, *the JTEK can automatically compensate for the errors in the thermocouple probe* using very simple everyday "kitchen equipment". The JTEK also incorporates an advanced electronic memory to retain calibration indefinitely (even if you remove the battery!) Of course, you can easily recalibrate.

Other more routine advanced features include the ability to store (for later recall) up to eight readings plus peak (maximum) and valley (minimum) readings, perform temperature differential measurements with a single probe, read in Celsius or Fahrenheit to .1 degree, all with an accuracy of better than 0.1%.

Introduction

This manual is organized for easy reference. All the display and key functions are clearly defined. Also, the operating instructions are task-oriented. Once you understand the startup procedures and basic adjustments, you can go directly to a particular operating instruction and quickly apply the unique capabilities of the J•T•E•K instrument to your specific application.

Some basic *application* data is provided to help you select the proper thermocouple. *Specifications* are provided near the back of the manual. The *Appendices* include temperature conversion formulas and information about error indications.

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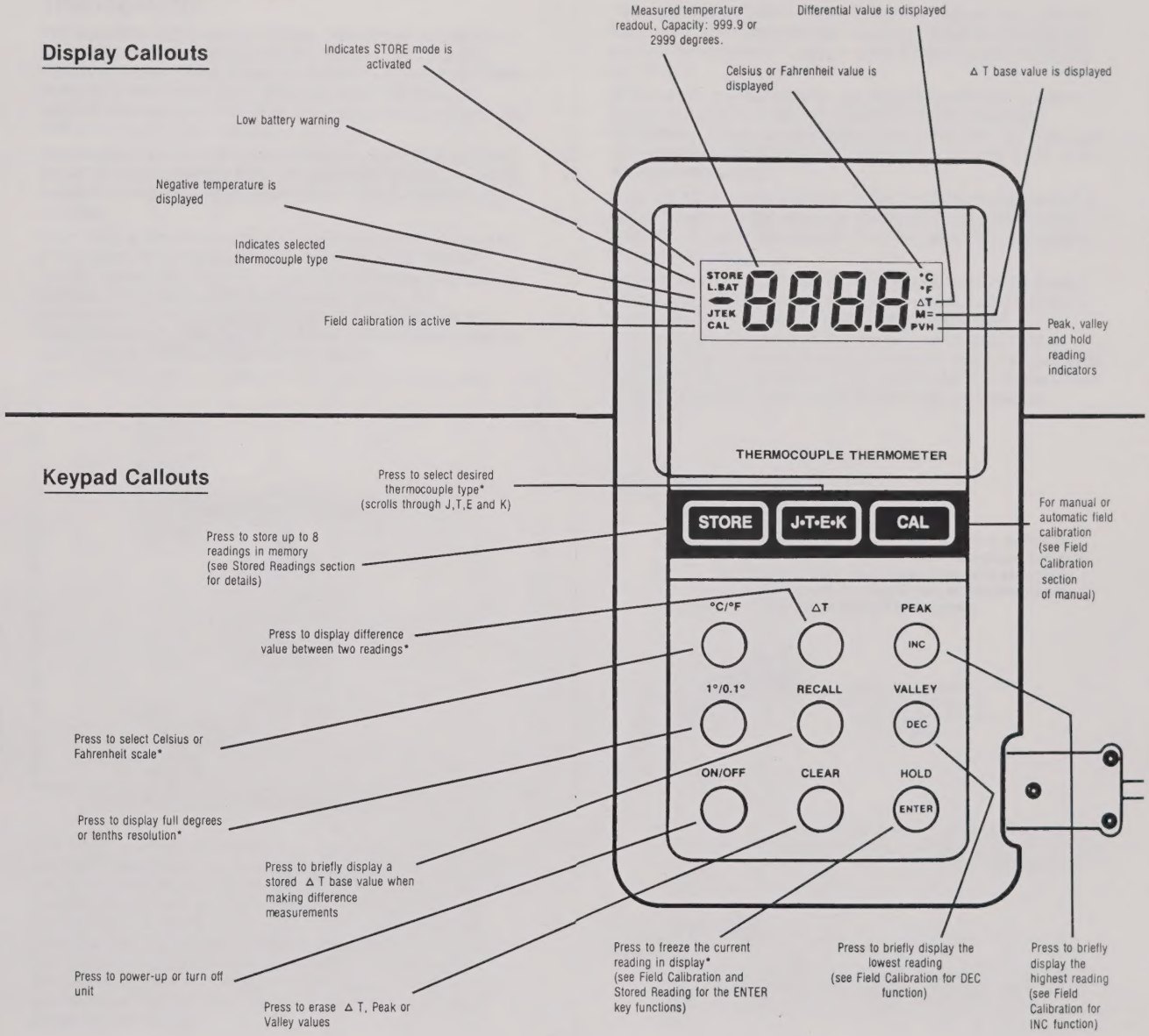
Readouts & Controls

Display Callouts


Measured temperature readout, Capacity: 999.9 or 2999 degrees.
Differential value is displayed
Indicates STORE mode is activated
Celsius or Fahrenheit value is displayed
Δ T base value is displayed
Low battery warning
Negative temperature is displayed
Indicates selected thermocouple type
Field calibration is active
STORE
L.BAT
JTEK
CAL
°C
°F
ΔT
M=
PVH
Peak, valley and hold reading indicators
THERMOCOUPLE THERMOMETER
Press to select desired thermocouple type* (scrolls through J,T,E and K)
For manual or automatic field calibration (see Field Calibration section of manual)
Press to store up to 8 readings in memory (see Stored Readings section for details)
STORE
J•T•E•K
CAL
°C/°F
ΔT
PEAK
INC
Press to display difference value between two readings*
1°/0.1°
RECALL
VALLEY
DEC
Press to select Celsius or Fahrenheit scale*
ON/OFF
CLEAR
HOLD
ENTER
Press to display full degrees or tenths resolution*
Press to briefly display a stored Δ T base value when making difference measurements
Press to power-up or turn off unit
Press to erase Δ T, Peak or Valley values
Press to freeze the current reading in display* (see Field Calibration and Stored Reading for the ENTER key functions)
Press to briefly display the lowest reading (see Field Calibration for DEC function)
Press to briefly display the highest reading (see Field Calibration for INC function)

Keypad Callouts

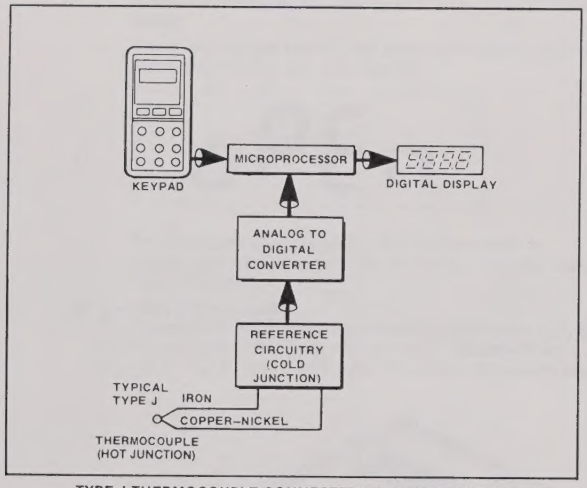
*Press again to toggle to the next function or back to original function.

Short-Course in Thermocouple Thermometry

The common temperature scales, Fahrenheit and Celsius (or Centigrade), are based on the freezing and boiling points of water. Thus, if we establish a *known* temperature value as a reference point (such as zero degrees), an appropriate sensing device at the measuring point can provide the actual temperature information.

Thermocouples are the favored sensors for measuring all kinds of temperatures. They provide high accuracy, rapid response, and easy application over wide temperature ranges.

How does a thermocouple sense temperature? It is composed of a pair of electrical conductors of *dissimilar* metals, joined to produce a proportional voltage when the applied temperature differs from the reference temperature. The following diagram summarizes how a thermocouple connected to a thermometer system senses and displays precise temperature values:



TYPE J THERMOCOUPLE CONNECTED TO THERMOMETER

The "hot" junction (composed of dissimilar wires) is connected in series to a voltage-measuring device. The instrument includes electronic circuitry to simulate the reference junction immersed in "ice". When the hot junction is placed at a measurement point, the generated voltage changes as fast as the applied temperature. This information is transmitted to the thermometer's circuitry and microprocessor which converts the analog values of the proportional voltage into discrete, easy-to-read digital temperature values.

Application Data

The versatile J•T•E•K thermometer is teamed up with the most common thermocouple types to measure and display precise temperature values—even under rapidly changing conditions.

Differential measurements can be made *without* a second probe; there's no need for matched probes and time-consuming offset adjustments. Just press the Δ T key and instantly see change values in temperature over time or at different locations.

Ideal for applications where quick, multiple measurements are required—it can *store* as many as eight temperature readings for later display. (And it can also indicate peak or valley readings.)

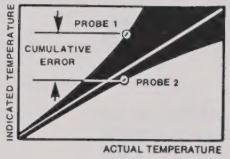
Selection of a J, T, E or K thermocouple should be based on the temperature range of the application, the nature of the environment in which it will be exposed (the temperature source), and the desired accuracy. These probes transfer temperature information when immersed in gases, liquids, or in contact with surfaces. The comparison table in Appendix C provides some basic application guidelines.

Probe Accuracy Considerations

For Differential Measurements

One vs. Two-Probe Systems

The single-probe J•T•E•K thermometer has a significant accuracy advantage over conventional two-probe systems. The reason? *Cumulative error.* Over time, and especially when subjected to high temperatures, all thermocouples experience slight degradations in accuracy.



Potential cumulative error when making differential measurements with two probes.

The graph shows a potential cumulative error when using two probes to obtain temperature difference values. Thus, a single-probe instrument, like the J•T•E•K, minimizes this error.

Startup procedures

Cautions:

(1) The J•T•E•K instrument is designed to accept low level signals supplied by standard thermocouples. Under no circumstances should input exceed the specified 10 volt peak.

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(2) Do not use or store the J•T•E•K instrument in microwave ovens or any abnormally hot or cold areas.

(3) Avoid making sharp bends and/or many flexures in the thermocouple leads.

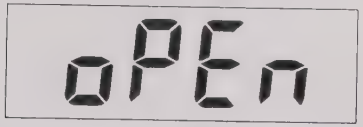
The J•T•E•K Thermometer is furnished ready to use after installation of battery (furnished) and thermocouple (not furnished). Follow this startup procedure:

(1) Install battery
See "Battery Replacement" in MAINTENANCE section.

(2) Verify diagnostic display
☐ Press the ON key. Be sure all the display annunciators flash on for about a second to verify that the unit is functional:

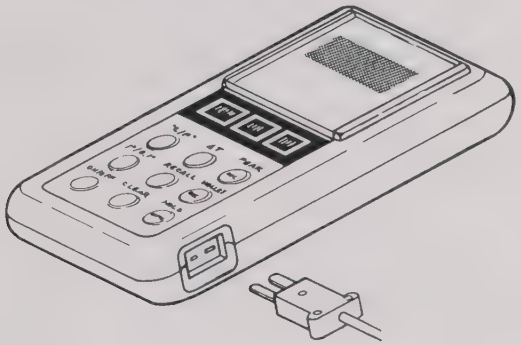
If this self-check indication doesn't occur, contact your dealer.

If a thermocouple has not yet been connected to the instrument, you will see this display:



This message also appears if the thermocouple is broken. No measurements can be made while this warning is displayed.

(3) Connect thermocouple
This instrument accommodates thermocouple types J, T, E and K, with polarized plugs. Be sure your instrument setting (J, T, E or K) matches the thermocouple you are using.



Caution: Do not try to force large blade into small receptacle.

(4) Check default settings
When you press the ON key, the J•T•E•K instrument will power up with the same settings that were set when the unit was last turned off.

If you are using the J•T•E•K for the first time as shipped from the factory, the unit will default to a type K thermocouple, reading in °C with 0.1° resolution.

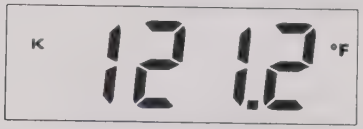
Operating Procedures

The J•T•E•K instrument adapts instantly to individual application needs due to its many dual function keys. The J•T•E•K can be used with thermocouples placed in air, gas, liquid, or in contact with a surface. The following instructions show example displays with default settings (K thermocouple, °F scale and 0.1° resolution).

Warm-up Time — For optimum operation, allow about one minute for ambient temperature stabilization. If the unit has been stored at an extreme ambient condition, more time may be needed.

With the instrument turned ON, proceed with any of the following task-oriented instructions:

(1) Basic Temperature Reading
☐ Place the probe at the point of measurement. The display will quickly show the exact temperature. For example, you might get a reading like this:



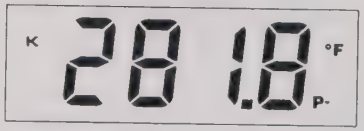
In this basic application, you don't have to press anything but the ON key.

(2) Peak Readings
The J•T•E•K instrument is ideal for monitoring *unattended* operations. While continually displaying every temperature change that occurs, its active memory automatically stores the *highest* value sensed until you are ready to take the reading.

Caution:

Do not turn the instrument OFF when a stored peak temperature value may be wanted; memory contents will be lost.

☐ When you want to momentarily display the *highest* stored temperature value press the PEAK key. For example:



Note that the "P" symbol appears in the display to confirm the peak value reading. This notation appears briefly, but you can repeat the function by pressing the PEAK key again.

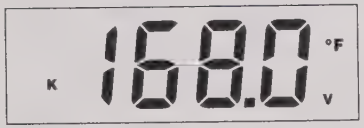
After displaying the peak value, the instrument will then automatically return to its normal operating mode, displaying the current temperature at the measurement point.

☐ To take a new peak measurement at a *different* measurement point, remove the stored peak value by pressing in sequence the CLEAR and PEAK keys. The instrument will be reprogrammed to continually store the *new* highest temperature value. To read it, repeat the preceding procedure.

(3) Valley Readings

Similar to Peak readings, except the instrument briefly displays the *lowest* temperature measurement since power-up or last CLEAR command.

☐ Press the VALLEY key. For example, your reading might be:



The "V" in display verifies the Valley reading. Then the instrument automatically returns to its normal operating mode, displaying the current temperature at the measurement point.

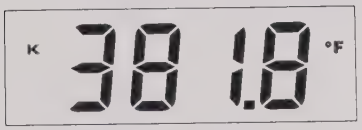
☐ To take a *new* Valley measurement at a different location, erase the stored Valley value by pressing in sequence the CLEAR and VALLEY keys.

The instrument will again continually store each lowest temperature value. To read it, as before, just press the VALLEY key.

(4) Hold Readings

When temperature measurements are made in cramped or poorly lighted places, use the *hold* function to freeze the displayed value until it's more convenient to read. Otherwise, the reading would change, depending on the new location of the probe. Follow this procedure:

☐ Place the probe at the measurement point. For example, you might get a reading like this:



☐ Press the HOLD key. Withdraw the probe. The display will retain the temperature reading.

Note the "H" symbol in the display to confirm the displayed value is being held.

☐ To disengage this function, press the HOLD key again. Then check the display to verify that the "H" annunciator symbol has disappeared.

(5) PEAK/VALLEY HOLD Readings

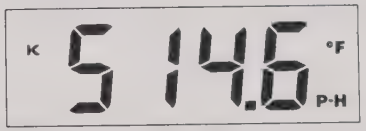
The J•T•E•K thermometer can *combine* the Peak-Hold or Valley-Hold functions:

PEAK/HOLD - To display the *highest* temperature reading since power up or last CLEAR command, follow this procedure:

☐ Press the HOLD key.

☐ Press the PEAK key.

Note that the "P H" annunciators will confirm this operating mode. An example Peak/Hold reading might look like this:



This peak reading will *remain* in the display until the temperature increases.

Some time later, if the temperature had increased 10 degrees, the display will automatically show:

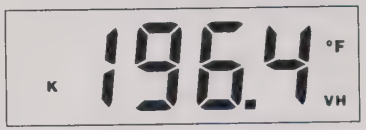
☐ To disengage these combined functions, press the HOLD key.

VALLEY/HOLD — To display the *lowest* temperature reading since power up or last CLEAR command, follow this procedure:

☐ Press the HOLD key.

☐ Press the VALLEY key.

Note that the "V H" indicators will confirm this operating mode. Here's an example display:



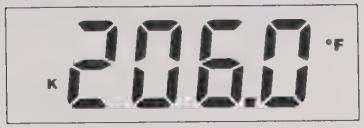
This lowest temperature reading will remain in the display until the measured temperature decreases.

☐ To disengage these combined functions, press the HOLD key again.

(6) Differential Readings (Δ T Mode)

A single probe is used to take dual-point measurements, or measurements at the same point over time. The J•T•E•K displays the *difference* values. A common application is measuring inlet/outlet temperature. Follow this procedure:

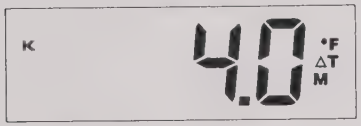
☐ Place the probe at the *first* measurement point. For example, the temperature can read:



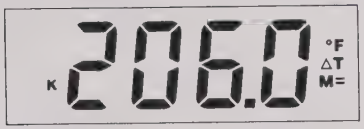
☐ Press the Delta-T (Δ T) key to store this base value. Thereafter, every reading will be a *difference* value based on the initial measurement.

(Note that the " Δ T" and "M" symbols will appear in the display to confirm that the values shown are differences between a measurement in memory and a new measurement. The "M" appears, denoting that a base value is stored in memory. The " Δ T" indicates that the differential mode has been selected.

☐ Place the probe at the *second* measurement point. The display will immediately show the precise difference between the original base value and the new measurement value. For example, if the second temperature is 210°, the display will show the differential reading:



☐ If you wish to momentarily display the original base value, press the RECALL key. Your display will again look like this:



The "M = " symbol confirms that the original stored base value is being displayed.

☐ Press the Δ T key to toggle between the actual measured and differential temperature measurements — without affecting the base value.

☐ To remove the original base value to make new differential measurements (or to disengage from this mode), it is necessary to remove the "M = " symbol. Do this by pressing in sequence the CLEAR and Δ T keys. Then place the probe at the next measurement point and repeat this procedure.

NOTE:

For a complete description of the RECALL and CLEAR functions, refer to "Memory Capabilities" in the Specifications Section.

(7) Stored Readings

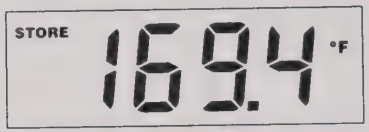
The STORE function allows you to save as many as eight readings in memory for instant recall at any later time — very useful in applications where it's not convenient to write down a series of measurements. This information can be retained for literally years until you erase it, even if the battery is removed. Here's the procedure:

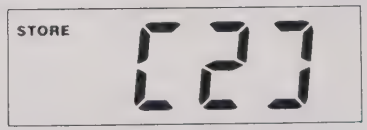
☐ When the display shows a reading you wish to store, for example, 169.4, simply press the STORE key. The display will show the next available storage location in brackets:

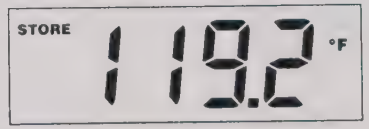
☐ Press the ENTER key. This will save the reading.

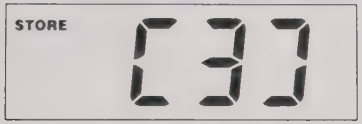
☐ Repeat the preceding 2 steps for as many as 7 additional readings. If you try to store more than 8 readings, the display will indicate "Full".

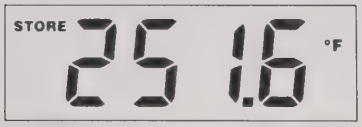
☐ Later, to view the stored readings, press the STORE and RECALL keys. The display will sequentially show each stored reading. For example:











As mentioned, the above sequence will continue for all readings (not exceeding 8) that you stored.

☐ To erase *all* the stored readings, press in sequence the STORE and CLEAR keys. The unit will revert to normal operation, and the next time you use the Store function, the display will start with the first [1] memory location.

(8) Field Calibration

The new CAL function allows single-point calibration of the probe, either manually or automatically.

NOTE:

The J•T•E•K has a memory retention capability to hold a separate calibration value for each of the four thermocouple types, even while the power is off. When you resume the same job, there's no need to recalibrate.

Manual Calibration — Here's how to field calibrate the probe at any desired temperature:

☐ Place probe at reference temperature point.

☐ Press the CAL key. Note that the CAL indicator will blink.

☐ Hold down either the INC (increment) or DEC (decrement) key until the desired calibration temperature is displayed. For example, if the current reading is higher than the reference temperature, press the DEC key until the display reads the actual calibration reference temperature.

☐ Press the ENTER key to store this new calibration offset value.

The CAL indicator will stop blinking, but will remain in the display to verify that the displayed readings now include a field calibration offset.

☐ To erase the calibration offset, press in sequence the CAL and CLEAR keys.

Automatic Calibration

In the automatic calibration mode, the instrument self-calibrates to the freezing or boiling points of water:

freezing: 0°C or 32°F
boiling: 100°C or 212°F

Here's the procedure:

☐ Place probe in boiling or ice water, let stabilize.

☐ Press in sequence the CAL and ENTER keys. The unit will automatically detect at which point (freezing or boiling) it is near and calibrate to that point.

The CAL indicator remains to verify that this and all subsequent displayed readings include a field calibration offset.

NOTE:

The temperature at which water boils (100°C/212°F) is at sea level and standard atmospheric pressure. Changes in altitude and barometric pressure will cause the boiling temperature to change.

As a rule of thumb, the boiling temperature of water will decrease 1°C (1.8°F) for every 1000 feet above sea level. For example, Denver, CO elevation 5300 feet, water will boil at approximately 94.7°C (202.5°F).

Other liquids may also be used as calibration standards. Consult a chemical handbook for their freezing (melting) point and boiling point properties.

Specifications

Operational Ranges

The J•T•E•K instrument has a high number of calibration points over extended ANSI ranges for thermocouples. This permits meter calibration accuracy to better than .4 C over full range, with no discontinuities of jumps from one reading to the next. Noiseless readings are provided via microprocessor signal averaging and front-end analog signal filters.

Range/Accuracy

Thermocouple Type	Temperature Range		Accuracy
	°C	°F	
J	−190 to 1000°	−310 to 1832°	0.1% Reading ±0.4°C (±1.0°C for temperature indications < −150°C)
K	−250 to 1375°	−418 to 2507°	
E	−250 to 1000°	−418 to 1832°	
T	−250 to 400°	−418 to 752°	

Displays

Easy-reading LCD annunciators provide a large 4-digit temperature reading display. In applications where temperatures are rapidly changing the display updates continuously. Since each reading represents a sliding average of 16 measurements, fluctuating temperatures will become easier to read. Individual annunciators verify every operating mode. (See page 4)

Also, an "oPEn" display warns you if the thermocouple

connection to instrument is faulty or absent.

Switchable Resolution

The J•T•E•K has a resolution key (1°/0.1°) to give you the option of displaying measurements in either full degrees (up to 2999) or in tenths of a degree (up to 999.9). If the source temperature exceeds the 999.9 limit when using the 0.1° mode, the display will automatically drop the 1/10th function and show full degrees. There is no need to disassemble the unit to change the resolution. Simply toggle the resolution key to either mode.

Thermocouple Input

Connector: ANSI standard mini-connector.

Accommodates J, T, E, or K thermocouples.

Protection: 10 volt peak

Differential Linearity

Over 100 degree span ±.3°C.

Ambient Temperature/Humidity

Full accuracy: 23°C ±5°

Useful range: 23°C ±15°

Storage: −40 to +50°C.

Humidity: 80%, non-condensing at 33°C.

Construction

The J•T•E•K is enclosed in a rugged, chemical-resistant ABS case, with a laminated membrane keypad to withstand hard use in laboratory or industrial environments. (It's also coffee-proof, if you don't overdo it). The display shield is made of durable plastic. Solid-state circuitry withstands shocks. Carry it anywhere, even in the toolbox.

A built-in stand tilts the instrument upward to improve readability when used on a lab shelf or bench. Also has anti-skid pads.

Battery

Supplied with 9V transistor NEDA Type 1604 battery. Alkaline type provides about 75-100 hours life.

Case Dimensions

6 x 3 x 1" thick. Weight, about 8 oz.

Maintenance Procedures

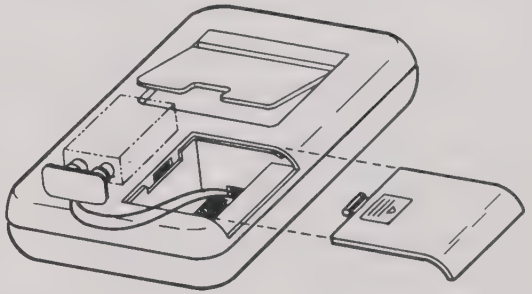
Cleaning the Case

The J•T•E•K instrument can be used in applications where sanitation standards are high. Keep the case clean by using just a mild detergent. Avoid immersion and excess fluid.

Battery Replacement

A "L.BAT" notation in the display will warn you when there is 10-15 hours of useful life remaining. Replace with same type (NEDA 1604). The battery compartment is on the backside. To open, push cover in direction of arrow.

NOTE: When the "L.BAT" indicator is on, the electronic memory is disabled. An "Err6" message will briefly appear when the unit is turned off indicating STORE and CAL constants will *not* be saved.



Caution:

Be sure to disconnect probe when changing battery. This will avoid any possible electrical shock hazard if the probe is accidentally connected to a high voltage source.

Repair Service

There are no internal adjustments to be made by user. Properly used, the unit should maintain calibration. Contact your dealer if you have service needs.

Accessories

The J•T•E•K can be used with a wide range of probes. Consult your dealer.

Warranty

Consult your dealer and/or Factory Warranty Card for appropriate warranty terms.

Appendix A

Temperature conversion formulas

Since one Fahrenheit degree is 5/9 of a centigrade degree, the following formulas apply:

$$F = (9/5)\,C + 32$$
$$C = (5/9)\,(F - 32)$$

Thus, to convert centigrade degrees to Fahrenheit, multiply by 9, divide by 5, and add 32.

Appendix B

Error Displays

The J•T•E•K automatically warns you when the instrument can't accommodate normal operations.

Error Code	Condition	Remedy
o P E n	Open sensor	Check probe connection
E r r 1	Input, underrange	Check probe & type
E r r 2	Input, overrange	Check probe & type
E r r 3	RAM check	Return unit for service
E r r 4	ROM check	
E r r 5	Timer check	
E r r 6	Memory Disabled	Replace Battery

Appendix C

Basic Guidelines for Thermocouple Selection

Thermocouple Type	Temperature Range		Thermocouple Materials	COLOR CODES			Application Areas
	Standard ASTM	Extended NBS		Body	Pos Lead	Neg Lead	
J	0 to 760°C 32 to 1336°F	-190 to 1000°C -310 to 1832°F	JN Constantan JP Iron	Black	White	Red	• Vacuum conditions • Oxidizing, Reducing, or Inert atmospheres • Plastics industries
K	-250 to 1260°C -418 to 2300°F	-250 to 1375°C -418 to 2507°F	KN Alumel KP Chromel	Yellow	Yellow	Red	• Inert atmospheres • Oxidizing atmospheres • Wide application probe • General purpose
E	-250 to 871°C -418 to 1600°F	-250 to 1000°C -418 to 1832°F	EN Constantan EP Chromel	Violet	Violet	Red	• Inert atmospheres • Oxidizing atmospheres • Power and Utilities industries
T	-184 to 371°C -299 to 700°F	-250 to 400°C -418 to 752°F	TN Constantan TP Copper	Blue	Blue	Red	• Oxidizing, Reducing, or Inert atmospheres • Biomedical • Food processing

Thermocouple Recommendations

TYPE J For use in the temperature range from 0 to 760°C in vacuum, oxidizing, reducing or inert atmospheres. If used for extended times above 500°C, heavy gage wires are recommended because the oxidation rate is rapid at elevated temperatures.

TYPE T For use in the temperature range from −184 to 371°C in vacuum or in oxidizing, reducing or inert atmospheres. The positive thermoelement oxidizes rapidly above 371°C.

TYPE E For use in the temperature range from −250 to 871°C in oxidizing or inert atmospheres. The negative thermoelement is subject to deterioration above 871°C, but the thermocouple may be used up to 1000°C for short periods.

TYPE K For continuous use at temperatures within range −250 to 1260°C in oxidizing or inert atmospheres. Both thermoelements are subject to oxidation above 850°C, but even so, the thermocouple may be used up to 1350°C for short periods with only small changes in calibration. When oxidation occurs it normally leads to a gradual increase in the thermoelectric voltage with time. The magnitude of change in the thermoelectric voltage and the physical life of the thermocouple will depend on such factors as temperature, time at temperature, diameter of the thermoelements and conditions of use.

Thermocouple Restrictions

TYPE J Should NOT be used in sulfurous atmospheres above 500°C.

Should NOT be cycled above 760°C even for a short time if accurate readings below 760°C are desired at a later time.

Because of potential rusting and embrittlement, they are NOT recommended for sub-zero temperatures.

TYPE T Is NOT well suited for use in nuclear environments since both thermoelements are subject to significant changes in composition under thermal neutron irradiation. The copper in the thermoelements is converted to nickel and zinc.

Operation in hydrogen atmospheres at temperatures above 370 °C is NOT recommended since severe embrittlement of the positive thermoelement may occur.

TYPE E Should NOT be used in sulfurous, reducing or alternately reducing and oxidizing atmospheres unless suitably protected with protecting tubes.

Should NOT be used in vacuum (at high temperatures) for extended times because the chromium in the positive thermoelement vaporizes out of solution and alters calibration.

Should NOT be used in atmospheres that promote "green-rot" corrosion (those with low, but not negligible, oxygen content).

TYPE K Should NOT be used sulfurous, reducing or alternately reducing and oxidizing atmospheres unless suitably protected with protecting tubes.

Should NOT be used in vacuum (at high temperatures) for extended times because the chromium in the positive thermoelement vaporizes out of solution and alters calibration.

Should NOT be used in atmospheres that promote "green-rot" corrosion (those with low, but not negligible, oxygen content).

References:

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ASTM Special Tech. Publ. 470, (1970).

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NBS Monograph 125.

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